AR-496

Behind/Beyond future cities

Coccolo Silvia, Mauree Dasaraden

Cursus	Sem.	Type
Architecture	MA2, MA4	Opt.
Minor in Engineering for sustainability	E	Opt.
Minor in Integrated Design, Architecture and Sustainability	E	Opt.
Territories in transformation and climate minor	E	Opt.
Urban Planning and Territorial Development minor	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	12
Hours	**2 weekly**
Lecture	2 weekly
Number of positions	

Summary

We are living in an urban world and the design of sustainable cities is essential in order to decrease our energy footprint. This course provides the instruments to understand the complex urban metabolism, as well as the solutions for planning future smart and sustainable cities.

Content

We live in a world that is more and more urbanised (over 50% of the world population lives in cities since 2010) and architects, urban planners and other stakeholders have to rethink their projects to integrate them to an urban context. In the architecture curriculum at the Bachelor and Master level, students have been introduced to the fundamentals and principles of building science as well as other courses that focus on the urban scale. However, none of these courses focus on the physics behind metabolism and sustainability of future districts and cities. The objective of this course is to provide the instruments to understand and to quantify the urban metabolism, focusing on the urban climate, the buildings energy design and the liveability of the spaces between buildings.

Keywords

- Sustainable Urban Planning
- Urban Climate
- Urban Metabolism
- Energy Systems
- Integration of Renewable Energies
- Human Thermal Perception
- Urban Greening

Learning Prerequisites

Recommended courses

Basic knowledge of physics.

Important concepts to start the course

Fundamental concept on Urbanism and Sustainability.

Learning Outcomes

By the end of the course, the student must be able to:

- Manage the physical principles and the energy fluxes within the urban environment.
- Transpose the fundamentals of urban climate on its applications and assess the impact of urban spaces on the energy demand and pedestrians thermal comfort and health.
- Analyze the impact of climate change from the global to the local scale.
- Develop an experimental campaign to measure meteorological variables.
- Synthesize and analyse the monitoring data, as well as their application for a sustainable urban design.
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Transversal skills

- Take account of the social and human dimensions of the engineering profession.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Demonstrate a capacity for creativity.
- Take feedback (critique) and respond in an appropriate manner.
- Collect data.

Teaching methods

The course is subdivided into two main parts: i) in class teaching and ii) a practical exercise. The teaching part is broken down into five main topics: i) the link between the building and the city scale, ii) the urban climate and the space between buildings, iii) the energy aspects, iv) the intangible aspects behind the city and finally v) a general perspective with reflections on how cities influence the national and global systems. The practical exercise consists in one-day monitoring study of the microclimate of the EPFL campus, focusing on the impact of the campus design on the energy demand of buildings and on the pedestrian's thermal perception.

Expected student activities

Students are expected to actively participate to the course. Each student will work on one-day monitoring study on the EPFL campus, focusing on the microclimatic conditions of the site. All the measurements will be collected, stored and shared between the students in an online platform. During the semester each group will analyse the monitoring data, and provide a comprehensive study on the assigned theme, as well as practical recommendations for the sustainable design of the campus.

Assessment methods

The evaluation is based on the active participation to the measurement campaign (20%), a written report (40%) and a final presentation (40%) of the work performed during the semester, based on the monitoring study.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes
Others	Online virtual platform to store and share the acquired data

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

A comprehensive bibliography is provided during each course.
The following readings are recommended during the semester:
Erell, Pearlmutter, Williamson (2011). *Urban Microclimate. Designing the Spaces between Buildings*. Earthscan
Ng (2010). *Designing High-density cities. For social and Environmental Sustainability*. Earthscan
Robinson (2011). *Computer Modelling for Sustainable Urban Design: Physical Principles, Methods and Applications*. Earthscan
Santamouris (2016). *Urban Climate Mitigations Techniques*. Routledge
Pearlmutter and al. (2017). *The urban forest. Cultivating Green Infrastructure for People and the Environment.* Springer

Ressources en bibliothèque

- Urban microclimate / Erell
- Urban climate mitigations techniques / Santamouris
- The urban forest / Pearlmutter
- Designing high-density cities / Ng
- Computer modelling for sustainable urban design / Robinson

Notes/Handbook

All the courses are available on the Moodle, as well as the digital book.

Moodle Link

- https://go.epfl.ch/AR-496